

Heavy Flavor Averaging Group

Aug. 2006

Compilation of B^+ Semi-leptonic and Radiative Branching Fractions

All branching fractions are in units of 10^{-6}

In PDG2006 **New since PDG2006 (preliminary)** **New since PDG2006 (published)**

RPP#	Mode	PDG2006 Avg.	BABAR	Belle	CLEO	New Avg.
240	$K^*(892)^+\gamma$	40.3 ± 2.6	$38.7 \pm 2.8 \pm 2.6$	$42.5 \pm 3.1 \pm 2.4$	$37.6^{+8.9}_{-8.3} \pm 2.8$	40.3 ± 2.6
241	$K_1(1270)^+\gamma$	$43 \pm 9 \pm 9$		$43 \pm 9 \pm 9$		43 ± 12
242	$K^+\eta\gamma$	$8.4^{+1.5}_{-1.2} \pm 0.9$	$10.0 \pm 1.3 \pm 0.5$	$8.4^{+1.5}_{-1.2} \pm 0.9$		9.4 ± 1.1
–	$K^+\eta'\gamma$	New	< 4.2			< 4.2
243	$K^+\phi\gamma$	$3.4 \pm 0.9 \pm 0.4$	$3.5 \pm 0.6 \pm 0.4$	$3.4 \pm 0.9 \pm 0.4$		3.5 ± 0.6
244	$K^+\pi^-\pi^+\gamma$ §	$25.0 \pm 1.8 \pm 2.2$	$29.5 \pm 1.3 \pm 1.9$	$25.0 \pm 1.8 \pm 2.2$		27.7 ± 1.8
–	$K^0\pi^+\pi^0\gamma$ §	New	$45.6 \pm 4.2 \pm 3.1$			45.6 ± 5.2
245	$K^{*0}\pi^+\gamma$ §	20^{+7}_{-6}		$20^{+7}_{-6} \pm 2$		20^{+7}_{-6}
245	$K^+\rho^0\gamma$ §	< 20		< 20		< 20
247	$K^+\pi^-\pi^+\gamma$ (N.R.) §	< 9.2		< 9.2		< 9.2
248	$K_1(1400)^+\gamma$	< 50		< 15		< 15
249	$K_2^*(1430)^+\gamma$	$14.5 \pm 4.0 \pm 1.5$	$14.5 \pm 4.0 \pm 1.5$			14.5 ± 4.3
251	$K_3^*(1780)^+\gamma$	< 39		< 39		< 39
253	$\rho^+\gamma$	< 1.8	$1.06^{+0.35}_{-0.31} \pm 0.09$	$0.55^{+0.42+0.09}_{-0.36-0.08}$	< 13	$0.87^{+0.27}_{-0.25}$
296	$p\bar{\Lambda}\gamma$	$2.16^{+0.58}_{-0.53} \pm 0.20$		$2.16^{+0.58}_{-0.53} \pm 0.20$		$2.16^{+0.61}_{-0.57}$
297	$p\bar{\Sigma}^0\gamma$	< 4.6		< 4.6		< 4.6
317	$\pi^+\nu\bar{\nu}$	< 100	< 100			< 100
318	$K^+e^+e^-$	$0.80^{+0.22}_{-0.19}$	$0.42^{+0.12}_{-0.11} \pm 0.02$	$0.640^{+0.150+0.029}_{-0.134-0.031}$	< 2.4	$0.515^{+0.093}_{-0.090}$
319	$K^+\mu^+\mu^-$	$0.34^{+0.19}_{-0.14}$	$0.31^{+0.15}_{-0.12} \pm 0.03$	$0.628^{+0.110}_{-0.108} \pm 0.033$	< 3.68	0.516 ± 0.091
320	$K^+l^+l^-$	$0.53^{+0.11}_{-0.10} \pm 0.3$	$0.38^{+0.09}_{-0.08} \pm 0.02$	$0.632^{+0.092}_{-0.088} \pm 0.030$		0.505 ± 0.065
321	$K^+\nu\bar{\nu}$	< 52	< 52	< 36	< 240	< 36
322	$K^*(892)^+e^+e^-$	< 4.6	$0.75^{+0.76}_{-0.65} \pm 0.38$	$1.60^{+1.04+0.14}_{-0.87-0.19}$		$1.12^{+0.65}_{-0.58}$
323	$K^*(892)^+\mu^+\mu^-$	< 2.2	$0.97^{+0.94}_{-0.69} \pm 0.14$	$1.63^{+0.64+0.10}_{-0.54-0.13}$		$1.43^{+0.54}_{-0.45}$
324	$K^*(892)^+l^+l^-$	< 2.2	$0.73^{+0.50}_{-0.42} \pm 0.21$	$1.34^{+0.48+0.09}_{-0.40-0.10}$		$1.10^{+0.35}_{-0.31}$
327	$K^+e^+\mu^-$	< 0.8	< 0.09			< 0.09
328	$K^+e^-\mu^+$	< 6400	< 0.13			< 0.13
329	$K^{*+}e^\pm\mu^\mp$	< 7.9	< 1.4			< 1.4
330	$\pi^-e^+e^+$	< 1.6			< 1.6	< 1.6
331	$\pi^-\mu^+\mu^+$	< 1.4			< 1.4	< 1.4
332	$\pi^-e^+\mu^+$	< 1.3			< 1.3	< 1.3
333	$\rho^-e^+e^+$	< 2.6			< 2.6	< 2.6
334	$\rho^-\mu^+\mu^+$	< 5.0			< 5.0	< 5.0
335	$\rho^-e^+\mu^+$	< 3.3			< 3.3	< 3.3
336	$K^-e^+e^+$	< 1.0			< 1.0	< 1.0
337	$K^-\mu^+\mu^+$	< 1.8			< 1.8	< 1.8
338	$K^-e^+\mu^+$	< 2.0			< 2.0	< 2.0
339	$K^{*-}e^+e^+$	< 2.8			< 2.8	< 2.8
340	$K^{*-}\mu^+\mu^+$	< 8.3			< 8.3	< 8.3
341	$K^{*-}e^+\mu^+$	< 4.4			< 4.4	< 4.4
–	$\pi^+l^+l^-$	New	< 0.11			< 0.11

§ $M_{K^*\pi\pi} < 2.4 \text{ GeV}/c^2$

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RPP#	Mode	PDG2006 Avg.	BABAR	Belle	CLEO	New Avg.
213	$K^*(892)^0\gamma$	40.1 ± 2.0	$39.2 \pm 2.0 \pm 2.4$	$40.1 \pm 2.1 \pm 1.7$	$45.5_{-6.8}^{+7.2} \pm 3.4$	40.1 ± 2.0
214	$K^0\eta\gamma$	$8.7_{-2.7-1.6}^{+3.1+1.9}$	$11.3_{-2.6}^{+2.8} \pm 0.6$	$8.7_{-2.7-1.6}^{+3.1+1.9}$		$10.3_{-2.1}^{+2.3}$
–	$K^0\eta'\gamma$	New	< 6.6			< 6.6
215	$K^0\phi\gamma$	< 8.3	< 2.7	< 8.3		< 2.7
216	$K^+\pi^-\gamma$ †	4.6 ± 1.4		$4.6_{-1.2-0.7}^{+1.3+0.5}$		4.6 ± 1.4
217	$K^*(1410)^0\gamma$	< 130		< 130		< 130
218	$K^+\pi^-\gamma$ (N.R.) †	< 2.6		< 2.6		< 2.6
219	$K^0\pi^+\pi^-\gamma$	$24 \pm 4 \pm 3$	$18.5 \pm 2.1 \pm 1.2$	$24 \pm 4 \pm 3$		19.5 ± 2.2
–	$K^+\pi^-\pi^0\gamma$	New	$40.7 \pm 2.2 \pm 3.1$			40.7 ± 3.8
220	$K_1(1270)^0\gamma$	< 58		< 58		< 58
221	$K_1(1400)^0\gamma$	< 15		< 15		< 15
222	$K_2^*(1430)^0\gamma$	12.4 ± 2.4	$12.2 \pm 2.5 \pm 1.0$	$13 \pm 5 \pm 1$		12.4 ± 2.4
224	$K_3^*(1780)^0\gamma$	< 83		< 83		< 83
226	$\rho^0\gamma$	< 0.4	$0.77_{-0.19}^{+0.21} \pm 0.07$	$1.25_{-0.33-0.06}^{+0.37+0.07}$	< 17	$0.91_{-0.18}^{+0.19}$
227	$\omega\gamma$	< 0.8	$0.39_{-0.20}^{+0.24} \pm 0.03$	$0.56_{-0.27-0.10}^{+0.34+0.05}$	< 9.2	$0.45_{-0.17}^{+0.20}$
228	$\phi\gamma$	< 0.85	< 0.85		< 3.3	< 0.85
293	$K^0e^+e^-$	< 0.54	$0.13_{-0.11}^{+0.16} \pm 0.02$	$-0.070_{-0.082-0.028}^{+0.129+0.014}$	< 8.45	$0.038_{-0.079}^{+0.091}$
294	$K^0\mu^+\mu^-$	$0.20_{-0.10}^{+0.13}$	$0.59_{-0.26}^{+0.33} \pm 0.07$	$0.626_{-0.181-0.041}^{+0.217+0.038}$	< 6.64	$0.615_{-0.153}^{+0.184}$
295	$K^0l^+l^-$	< 0.68	$0.29_{-0.13}^{+0.16} \pm 0.03$	$0.328_{-0.113-0.026}^{+0.134+0.022}$		$0.312_{-0.088}^{+0.105}$
296	$K^*(892)^0e^+e^-$	< 2.4	$1.04_{-0.29}^{+0.33} \pm 0.11$	$1.85_{-0.49}^{+0.55} \pm 0.19$		$1.28_{-0.28}^{+0.30}$
297	$K^*(892)^0\mu^+\mu^-$	$1.22_{-0.32}^{+0.38}$	$0.87_{-0.33}^{+0.38} \pm 0.12$	$1.85_{-0.31}^{+0.35} \pm 0.10$		1.46 ± 0.25
298	$K^*(892)^0\nu\bar{\nu}$	< 1000		< 360		< 360
299	$K^*(892)^0l^+l^-$	1.17 ± 0.30	$0.81_{-0.19}^{+0.21} \pm 0.09$	$1.69_{-0.24}^{+0.26} \pm 0.11$		1.19 ± 0.17
301	$K^0e^\pm\mu^\pm$	< 4.0	< 0.27			< 0.27
302	$K(892)^0e^\pm\mu^\pm$	< 3.4	< 0.58			< 0.58
–	$\pi^0\ell^+\ell^-$	New	< 0.10			< 0.10

† $1.25 \text{ GeV}/c^2 < M_{K\pi} < 1.6 \text{ GeV}/c^2$

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RPP#	Mode	PDG2006 Avg.	BABAR	Belle	CLEO	New Avg.
63	$K_3^*(1780)\gamma$	< 37		< 2.8		< 2.8
70	$s\gamma$	343 ± 29	$327 \pm 18_{-41}^{+55}$	$355 \pm 32_{-31-7}^{+30+11}$	$321 \pm 43_{-29}^{+32}$	$355 \pm 24_{-10}^{+9} \pm 3$
–	$s\gamma$ with baryons	New			< 38 †	< 38 †
75	$\rho/\omega\gamma$	< 1.2	$1.01 \pm 0.21 \pm 0.08$	$1.32_{-0.31-0.09}^{+0.34+0.10}$	< 14	$1.11_{-0.18}^{+0.19}$
–	$K\eta\gamma$	New		$8.5_{-1.2}^{+1.3} \pm 0.9$		$8.5_{-1.5}^{+1.6}$
105	$se^+e^- \ddagger$	4.7 ± 1.3	$6.0 \pm 1.7 \pm 1.3$	$4.0 \pm 1.3_{-0.8}^{+0.9}$	< 57	4.7 ± 1.3
106	$s\mu^+\mu^-$	4.3 ± 1.2	$5.0 \pm 2.8 \pm 1.2$	$4.1 \pm 1.1_{-0.8}^{+0.9}$	< 58	$4.3_{-1.2}^{+1.3}$
107	$sl^+\ell^- \ddagger$	4.5 ± 1.0	$5.6 \pm 1.5 \pm 1.3$	$4.11 \pm 0.83_{-0.81}^{+0.85}$	< 42	$4.50_{-1.01}^{+1.03}$
108	Ke^+e^-	$0.60_{-0.12}^{+0.14}$	$0.33_{-0.08}^{+0.09} \pm 0.02$	$0.454_{-0.104-0.025}^{+0.116+0.023}$		$0.380_{-0.067}^{+0.073}$
109	$K^*(892)e^+e^-$	$1.24_{-0.32}^{+0.37}$	$0.97_{-0.27}^{+0.30} \pm 0.14$	$1.84_{-0.44}^{+0.48} \pm 0.17$		1.25 ± 0.27
110	$K\mu^+\mu^-$	$0.47_{-0.10}^{+0.11}$	$0.35_{-0.11}^{+0.13} \pm 0.03$	$0.626_{-0.064-0.034}^{+0.103+0.033}$		$0.561_{-0.061}^{+0.066}$
111	$K^*(892)\mu^+\mu^-$	$1.19_{-0.29}^{+0.34}$	$0.88_{-0.30}^{+0.35} \pm 0.12$	$1.81_{-0.28}^{+0.30} \pm 0.11$		1.44 ± 0.23
112	$K\ell^+\ell^-$	0.54 ± 0.08	$0.34 \pm 0.07 \pm 0.02$	$0.550_{-0.070}^{+0.075} \pm 0.027$	< 1.7	0.442 ± 0.052
113	$K^*(892)\ell^+\ell^-$	1.05 ± 0.20	$0.78_{-0.17}^{+0.19} \pm 0.11$	$1.65_{-0.22}^{+0.23} \pm 0.11$	< 3.3	1.17 ± 0.16
115	$\pi e^\pm\mu^\mp$	< 1.6			< 1.6	< 1.6
116	$\rho e^\pm\mu^\mp$	< 3.2			< 3.2	< 3.2
117	$Ke^\pm\mu^\mp$	< 1.6	< 0.038		< 1.6	< 0.038
118	$K^*e^\pm\mu^\mp$	< 6.2	< 0.51		< 6.2	< 0.51
–	$\pi\ell^+\ell^-$	New	< 0.08			< 0.08

† $E_\gamma > 2.0$ GeV; ‡ $M(\ell^+\ell^-) > 0.2$ GeV/ c^2

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Compilation of B Inclusive Branching Fractions
All branching fractions are in units of 10^{-6}

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New since PDG2006 (preliminary) New since PDG2006 (published)

RPP#	Mode	PDG2006 Avg.	BABAR	Belle	CLEO	New Avg.
–	$K^+ X$	New	196^{+37+31}_{-34-30}			196^{+48}_{-45}
–	$K^0 X$	New	154^{+55+55}_{-48-41}			154^{+77}_{-63}

† $p^* > 2.34$ GeV

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Compilation of B Leptonic Branching Fractions
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In PDG2006

New since PDG2006 (preliminary) New since PDG2006 (published)

RPP#	Mode	PDG2006 Avg.	BABAR	Belle	CLEO	CDF	D0	New Avg.
15	$e^+ \nu$	< 15		< 5.4	< 15			< 5.4
16	$\mu^+ \nu$	< 6.6	< 6.6	< 2.0	< 21			< 2.0
17	$\tau^+ \nu$	< 260	$88 \pm 68 \pm 11$	179^{+56+39}_{-49-46}	< 840			134^{+48}_{-47}
18	$e^+ \nu_e \gamma$	< 200		< 22	< 200			< 22
19	$\mu^+ \nu_\mu \gamma$	< 52		< 23	< 52			< 23
290	$\gamma \gamma$	< 0.62	< 1.7	< 0.62				< 0.62
291	$e^+ e^-$	< 0.061	< 0.061	< 0.19	< 0.83			< 0.061
292	$\mu^+ \mu^-$	< 0.039	< 0.083	< 0.16	< 0.61	< 0.023		< 0.023
–	$\tau^+ \tau^-$	New	< 4100					< 4100
300	$e^\pm \mu^\mp$	< 0.17	< 0.18	< 0.17	< 1.5			< 0.17
303	$e^\pm \tau^\mp$	< 110			< 110			< 110
304	$\mu^\pm \tau^\mp$	< 38			< 38			< 38
305	$\nu \bar{\nu}$	< 220	< 220					< 220
306	$\nu \bar{\nu} \gamma$	< 47	< 47					< 47

Radiative and Leptonic Decays:

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